US Army Corps
of Engineers
Construction Engineering
Research Laboratory

CERL Technical Report 99/69
August 1999

Risks of Year 2000 Embedded Chip Problem to U.S. Army Installation Heating and Cooling Plants

Elizabeth Jeffers, LCDR Ted Theide, Tony Blacker, and Michael Brewer

Some computer systems may not correctly recognize dates after 31 December 1999. While much work has been done to prevent this failure in information systems, the effort to find and correct this problem in control systems using embedded chips has progressed less rapidly. Unless this problem is addressed, embedded systems in heating and cooling plants at U.S. Army installations may experience serious problems at or before the year 2000 calendar turnover. Embedded control systems may fail, reducing the reliability of installation utility plants.

This study was conducted to locate and publish information to: (1) help installations identify embedded chip equipment and common manufacturers of control equipment that may fail around the year 2000, (2) provide the status of Y2K compliance for common equipment, and (3) supply Internet links and contact points that will help locate equipment manufacturers.

19990907 122

DTIC QUALITY INSPECTED 4

Approved for public release; distribution is unlimited.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products. The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

DESTROY THIS REPORT WHEN IT IS NO LONGER NEEDED

DO NOT RETURN IT TO THE ORIGINATOR

USER EVALUATION OF REPORT

REFERENCE: CERL Technical Report 99/69, *Risks of Year 2000 Embedded Chip Problem to U.S. Army Installation Heating and Cooling Plants*

Please take a few minutes to answer the questions below, tear out this sheet, and return it to CERL. As user of this report, your customer comments will provide CERL with information essential for improving future reports.

1. Does this report satisfy a need? (Comment on purpose, related project, or other area of interest for which report will be used.)

_____

_____

_____

2. How, specifically, is the report being used? (Information source, design data or procedure, management procedure, source of ideas, etc.)

_____

_____

3. Has the information in this report led to any quantitative savings as far as manhours/contract dollars saved, operating costs avoided, efficiencies achieved, etc.? If so, please elaborate.

_____

_____

4. What is your evaluation of this report in the following areas?

a. Presentation: _____

b. Completeness: _____

c. Easy to Understand: _____

d. Easy to Implement: _____

e. Adequate Reference Material: _____

f. Relates to Area of Interest: _____

g. Did the report meet your expectations? _____

h. Does the report raise unanswered questions? _____

i. General Comments. (Indicate what you think should be changed to make this report and future reports of this type more responsive to your needs, more usable, improve readability, etc.)

5. If you would like to be contacted by the personnel who prepared this report to raise specific questions or discuss the topic, please fill in the following information.

Name: _____

Telephone Number: _____

Organization Address: _____

_____

_____

6. Please mail the completed form to:

Department of the Army
CONSTRUCTION ENGINEERING RESEARCH LABORATORY
ATTN: CEERD-IM-IT
P.O. Box 9005
Champaign, IL 61826-9005

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of Information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of

1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1999	Final

4. TITLE AND SUBTITLE

Risks of Year 2000 Embedded Chip Problem to U.S. Army Installation Heating and Cooling Plants

5. FUNDING NUMBERS

4A162784
AT45
X59

6. AUTHOR(S)

Elizabeth Jeffers, LCDR Ted Theide, Tony Blacker, and Michael Brewer

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Construction Engineering Research Laboratory (CERL)
P.O. Box 9005
Champaign, IL 61826-9005

8. PEFORMING ORGANIZATION REPORT NUMBER

TR 99/69

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Headquarters, U.S.Army Corps of Engineers (HQUSACE)
ATTN: CEMP-ET
20 Massachussetts Ave., NW.
Washington, DC 20314-1000

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

9. SUPPLEMENTARY NOTES

Copies are available from the National Technical Information Service, 5385 Port Royal Road, Springfield, VA 22161

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Some computer systems may not correctly recognize dates after 31 December 1999. While much work has been done to prevent this failure in information systems, the effort to find and correct this problem in control systems using embedded chips has progressed less rapidly. Unless this problem is addressed, embedded systems in heating and cooling plants at U.S. Army installations may experience serious problems at or before the year 2000 calendar turnover. Embedded control systems may fail, reducing the reliability of installation utility plants.

This study was conducted to locate and publish information to: (1) help installations identify embedded chip equipment and common manufacturers of control equipment that may fail around the year 2000, (2) provide the status of Y2K compliance for common equipment, and (3) supply Internet links and contact points that will help locate equipment manufacturers.

14. SUBJECT TERMS

heating plants
cooling systems
Y2K compliance
control equipment
computer chip

15. NUMBER OF PAGES

24

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ASTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

Foreword

This study was conducted for U.S. Army Corps of Engineers (USACE) under Project 4A162784AT45, "Energy and Energy Conservation;" Work Unit UL-X59, "Intelligent Automated Plant Systems." The technical monitor was Tim Gordon, CEMP-ET.

The work was performed by the Energy Branch (CF-E), of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Michael K. Brewer. Larry M. Windingland is Chief, CECER-CF-E and Dr. L. Michael Golish is Chief, CECER-CF. The technical editor was William J. Wolfe, Information Technology Laboratory.

The Director of CERL is Dr. Michael J. O'Connor.

Contents

1 Introduction

Background

The possibility that some computer systems may not correctly recognize dates after 31 December 1999 (the much publicized "Y2K" computer phenomenon) may cause significant problems for embedded systems at U.S. Army installations. Installations and vendors have been working to correct this problem in software systems for several years. However, while much work has been done to prevent failure of information systems, the effort to find and correct this problem in control systems using embedded chips did not start as early. Consequently, control systems may fail, reducing the reliability of installation heating and cooling plants.

Objectives

The objectives of this study were to:

- help identify embedded chip equipment and common manufacturers of control equipment that may fail around the year 2000
- supply internet links and contact points for equipment manufacturers
- provide the status of Y2K compliance for common equipment.

Approach

Research was conducted on heating and cooling equipment systems that may have date-time functions. Information was collected from public postings on the Internet, interviews with installation personnel, interviews with equipment manufacturers, and heating system operators.

Mode of Technology Transfer

The results of this research will forwarded to the Corps of Engineers Installation Support Center, Alexandria, VA (CEISC), the Assistant Chief of Staff for Installation Management (ACS[IM]), the General Services Administration (GSA), and

installation personnel identified in this study, to help installation maintenance personnel locate the needed tools to prepare utility systems for the Y2K date register rollover.

2 Explanation of Year 2000 Problem

Until the mid-1990's, it was common practice to use only the last two digits of a year to represent a date. For example, the computer recognizes the current year (1999) as "99" when performing any date-based function. This representation of the year causes no problems as long as the dates all occur in the 20th Century. However, when the calendar turns over to the year 2000, the computer will view the year's two-digit as the number "00" — a number with a value less than the number "99."

The turnover to the year 2000 was not considered when many existing systems were designed simply because the systems were not expected to last this long. However, many Y2K-noncompliant hardware and software systems are still in use and may experience major malfunctions as 1999 changes to the year 2000. The Y2K Problem will affect energy systems in two ways:

- Data arranged by date will no longer be arranged in the correct sequential order. For example, dates identified with the year "01" will be ambiguous. They will refer to both 1901 and 2001. Information associated with the year 2001 will most likely be stored incorrectly as information associated with the year 1901.
- The year 2000 is a leap year. According to the Institution of Electrical Engineers (IEE) [http://www.iee.org.uk/2000risk/w-73.htm]:

> Almost as important ... is that, in many cases, algorithms used to calculate whether a year is a leap year are wrong, and produce the result that Year 2000 is not a leap year, although in fact it is. Other errors result in Year 1900 being treated as a leap year, when in fact it is not; and some systems omit any provision for leap years. In consequence their calendar calculations are wrong.

3 Heating and Cooling System Automation

Definition of Embedded Systems

Most modern heating and cooling systems employ embedded technology to control and operate the system. The Institution of Electrical Engineers (IEE) [http://www.iee.org.uk/2000risk/] defines embedded systems as: "devices used to control, monitor or assist the operation of equipment, machinery or plant. 'Embedded' reflects the fact that they are an integral part of the system." In most systems, the controller may be so integral to a system or piece of equipment that its presence is not obvious to the casual observer. Even technicians familiar with embedded technology might need to study the equipment in operation for some time before being able to determine that an embedded control system is involved in its functioning. On the other hand, a computer used to control the overall operation of a plant obviously employs embedded chips.

An embedded system must contain a computer or microprocessor. However, many of these processors are very simple systems as compared to personal computers.

Embedded Technology in Heating and Cooling System Automation

The term "automation" implies a system with embedded controls. These controls may range in size and complexity from thermostats and gauges to main controlling computers. However, all embedded control do not necessarily operate on a date-time function. This means that some automated systems, such a heating or cooling system, will not fall victim to the Y2K problem. Therefore, it must be determined if the controllers in a system operate on a date-time function and if the controllers will be affected by the year 2000. These steps are outlined in Chapter 5, "Automated System Compliance Procedure."

4 Effects of Date-Time Function Non-Compliance

The possible effects of date-time function non-compliance in energy systems range from what would be considered a "non-event," to a potential system shut-down, to a (very unlikely) catastrophic failure. Probable consequences of the Y2K turnover are:

- Tests have shown that programmable thermostats will incur malfunctions. According to Systems Modelling Ltd. [http://www.iol.ie/sysmod/ sysmod.htm], of three different models, two stopped working when the year 2000 rolled over. The other model recorded the date as 1900. It is also likely that once a programmable thermostat shuts down, it will not start-up again.
- Valves are often remotely controlled with microchips, which are subject to the Y2K Problem. If a chip were to fail, the valve would either close completely, open completely, or remain locked in the failed position. Regardless, the valve failure could cause the entire system to shut down or to lose control.
- The control console will need to be checked for date-time compliance in a manner similar to checking a PC. A system's main controls may react similarly to the thermostat. The controls may stop working at the Y2K turnover, may not restart, or may record an incorrect date. If the console records an incorrect date, the other controllers in the loop may have difficulties with the date discrepancy. This could result in a system lockup or shutdown.

While the various scenarios for an energy system are not likely to produce catastrophic failures, loss of heating capabilities in the winter will be inconvenient. Also, note that local utilities may not guarantee to provide reliable power, gas, or water for a number of days surrounding the Y2K turnover. The Appendix to this report contains a table to track the local utilities' Y2K Readiness progress.

5 Automated System Compliance Procedure

Six standard steps are used to ascertain a system's Y2K Readiness:

1. **Awareness**. The year 2000 will cause problems in some embedded systems. Energy systems are embedded systems with known Y2K failures. It is necessary to continue with the compliance procedure. A team of Y2K trained specialists, consisting of engineers, technicians, and programmers, should be assembled to carry out the rest of the Y2K Compliance Procedure.

2. **Inventory**. A complete list should be compiled of every device, piece of equipment, software, and hardware used by the energy system — in short, anything using electricity or operating on a battery. This list should include the product description, its location, its manufacturer, and its supplier. The IEE's Inventory Contents [http://www.iee.org.uk/2000risk/w-104.htm] shows a good example. The manufacturer should also be contacted for its Y2K Compliance Statement.

3. **Assessment/Testing**. Every item containing a microchip or processor must be assessed and/or tested for Y2K compliance. The IEE has established guidelines for testing, shown at the website: http://www.iee.org.uk/2000risk/w-155.htm. Some precautions to observe during testing are:

   - *Never run tests on operational systems*: Sometimes this advice is impractical and testing on real systems cannot be avoided. Nevertheless testing on operational systems should be carried out only where there is absolutely no alternative. Furthermore, tests on operational systems should be performed only when the controlled systems are "down," i.e., when they are non-operational.
   - *Keep the testing separate from the operational system*. This applies to hardware, software, and data.
   - *Back up all data and software before beginning testing*.
   - *Ensure that the operational system can be restarted*. Do not do anything that might make the next restart different from the usual restart.
   - *Test core elements* (the hardware/software platform) before testing application software.
   - *Be aware of the possibility of corruption of data arising from system software.*

- *Ensure that the computing platform on which tests are run is identical to the operational system.*
- *Ensure that all test cases are covered.*
- *Ensure that all software modules are called when the program suite is tested.*
- *Keep the test system and re-test at intervals that reflect operational cycles.*
- *Ensure that the testing process does not result in licenses for software becoming erroneously time-expired or invalidated because of copying.*

4. **Process Analysis**. For the devices that fail, a remedial plan must be devised. This could involve replacing the microprocessor altogether or simply changing the programming code. This may involve contacting third party system integrators. The planned changes should be tested before implementation.

5. **Implementation**. After a remedial plan is implemented, the system should be tested again. In situations where the energy system (along with other infrastructure systems) is controlled by a network, it may be advisable to run a "system of systems" test. This type of integrated test would run all of the remediated systems simultaneously to test system interaction with the new code and devices. The White Sands Missile Range [http://www.hqda.army.mil/acsimweb/ops/y2kweb.doc] conducted such a "system of systems" test in October 1998. The newly implemented system should be closely monitored for performance anomalies.

6. **Contingency Planning**. The implemented changes should have averted any Y2K operational problems. However, it is still important to create a contingency plan. According to the IEE [http://www.iee.org.uk/2000risk/w-272.htm]:

> The purpose of contingency planning is to avoid or reduce the effects of unexpected, unpredicted or unpredictable failure(s), by ensuring that there is a plan of action(s) which will be followed should a failure occur. It is likely that in the first instance the emphasis will be on dealing with the consequences rather than with the causal failures. Contingency planning will also be concerned with the effects of failures which are beyond the control of the company affected, i.e., failures on the part of suppliers or, possibly, customers.

Also, note that, even though some suppliers have made a good faith effort toward compliance, they will not promise product reliability due to legal issues. Therefore a contingency plan must be in place.

A good contingency plan will also take the local utilities' Y2K readiness into consideration. Although utilities report they will be taking extra precautions to place their equipment in its most reliable condition, no utility has promised that there will not be interruptions. It is unreasonable for a utility to make such a promise, even if they have checked all of their systems, as they may have to interrupt service due to the failure of a component not under their control. Installations should consider having an alternate power source on hand to sustain core functions. Rental generators are a cost-effective option for short term needs. However, it is imperative that the units be reserved very soon as research has shown that all available units will soon be taken. An installation has two main options: to rent larger units from a national company, or to find local rental companies that can help to piece together units. One such national rental company is Aggreko [http://www.aggreko.com], which has established a national Y2K program to facilitate Y2K Contingency Planners. Industrial supply phone books and Internet resources can help identify rental generators. One good nationwide resource for installations wishing to rent from local companies is the American Rental Association website [http://www.ararental.org]. From this Web site, all nearby ARA members can be found and the search can even be narrowed to those that list generators in their inventory. If emergency generators are to be used, the installation must conduct a sustained load test for several days. Many times, backup systems pass short-run maintenance tests, but cannot operate continually due to fouled cooling systems.

Note that every phase of the Compliance Procedure should be carefully documented. This is especially true of the testing, remediation, and implementation steps, which often work in a circular manner. Documentation saves time and provides a guide when it is necessary to start again. The documentation process can be a tedious task, nearly as monumental as the Compliance Procedure itself.

While the cost of running and implementing a Y2K Compliance Procedure may seem burdensome, it is better to invest in Y2K Readiness than to risk the consequences of inaction. Also realize that date change problems will not all occur on 31 December 1999. Many programs with forecasting features may produce erroneous data months before the crossover date. Additionally, as the Year 2000 approaches, demand for necessary resources and experts are likely to rise dramatically. It will likely become difficult or impossible to schedule needed services as the critical date approaches.

6 Y2K Resources

The GSA is providing customers with vendor Y2K Compliance information at its Web site [http://y2k.lmi.org/gsa/ y2kproducts/]. The following website addresses link to equipment manufacturers that may be involved in the operation of energy systems, and that provide access to other informative Y2K-related Web sites. Many of these links open directly to a company's home page to account for the (likely) possibility that specific electronic links to Y2K sites will change:

ABB Instrumentation.
http://www.abb.com/

Alfa Laval/ABB Automation.
http://www.automation.alfalaval.se/
Comment: Alfa Laval offers Y2K Compliance services to its customers.

Allen Bradley (Rockwell Automation).
http://www.ragts.com/webstuff/y2k.nsf/Pages/
Comment: Details known Y2K problems and solutions with their products. Site also contains a Test Plan Template.

Ametek.
http://www.ametek.com/ametek/default.asp
Comment: Look under "About AMETEK" for Y2K information.

Analog Devices.
http://www.analog.com/world/quality/year_issues/product.html
Comment: Zero risk of Y2K problems with ADI products.

Bristol Babcock.
http://www.branom.com/COMPANIES/bristol.html
Comment: Contains a Product List of all current and obsolete products. Also good explanation of Y2K technical problems.

Elsag-Bailey.
http://www.ebpa.com/Y2K/
Comment: Site has Y2K turnover countdown and a Product Status List.

Fisher-Rosemount.

http://www.frco.com/

Comment: Provides product information and points of contact. (Links to other Fisher-Rosemount companies
http://www.frco.com/fr/visit/companys.dgw)

Foxboro.

http://www.foxboro.com/y2000/y2000sysprod.htm

Comment: Company provides a chart of Y2K Readiness Status.

GE Information Services.

http://www.geis.com/html/y2k_faq.html

Comment: Informative site.

Honeywell.

http://www.iac.honeywell.com/news/1997/yr2000.html

Comment: Most Honeywell products are compliant. Honeywell will work with those that aren't.

Intellution.

http://www.intellution.com/solutions/year2000 Site contains list of Product Compliance and other Y2K information.

Johnson Controls.

http://www.jci.com/cg-y2k/

Comment: Provides product and system compliance information.

Motorola.

http://www.mot-sps.com/

Comment: Contains complete Y2K Compliance information.

National Instruments.

http://www.natinst.com/year2000/productsummary.htm

Comment: Site provides solutions for noncompliant items.

Omega Engineering.

http://y2k.omega.com/

Comment: Omega provides a search to find information on specific products.

Rosemount, Inc.

http://www.rosemount.com/y2k/y2kprod.html

Comment: Contains product status table.

Shneider Automation (Modicon).

http://www.modicon.com/

Comment: Go to home page and then to Year 2000 results.

Siemens Energy and Automation.

http://www.aut.sea.siemens.com/yr2k/index.htm

Comment: Provides product information.

ACSIM.

http://www.hqda.army.mil/acsim/ops/y2k.htm

Comment: Provides information on all branches of the military and related Y2K information. Go to "Y2K News."

Dr. Ed Yardeni's homepage.

http://www.yardeni.com/y2kreporter.html

Comment: Excellent site. Contains information on every aspect of the Y2K Problem.

North American Energy Reliability Council.

http://www.nerc.com/~y2k/

Comment: Excellent site. Contains links to government, industry, and private sites.

Vendor2000 product search.

http://www.vendor2000.com/

Comment: A fairly massive database of vendors.

7 Status of U.S. Army Installation Utility Y2K Compliance Efforts

Each installation should be aware of its electric and gas utilities' Y2K Compliance Status. Knowledge of the utilities' standing will help each installation to better prepare for the consequences of the year 2000 rollover. Installations should obtain a written statement of their utilities' compliance status and plans to enable installation utility managers to make sound contingency plans. Information is provided where it could be obtained via the Internet. The Installation Utility Y2K Readiness Table (found in the Appendix to this report) is provided for participants of the Heat Plant Modernization Program. The table also serves as a master example for an overall Y2K Readiness checklist of the installation's heating and cooling system. As of first quarter 1999, no gas and electric utilities report being Y2K Compliant. Most utilities predict completion of implementation and testing sometime between June and December 1999.

To add to the difficulties of the compliance effort, some vendors on which the systems operate continue to report additional fixes are needed. For example, as of April 1999 Microsoft's NT [www.microsoft.com/ntworkstation/] Terminal Server Edition (TSE) was still not Y2K compliant. Microsoft has posted a set of Y2K fixes for TSE, but now admits that they are inadequate. This may lead some companies to think TSE is compliant when it is in fact not. Microsoft NT Service Pack 4 [www.microsoft.com/windows2000/ready/], scheduled to come out in May 1999, should fix TSE's Y2K compliance problems. Some companies will have to do further equipment testing after the installation of Service Pack 4.

8 Conclusion

This study has located information to help address the much publicized Y2K computer problem as it relates to embedded systems in heating and cooling plants at U.S. Army installations. Information has been found to:

1. Help U.S. Army installation maintenance personnel identify embedded chip equipment and common manufacturers of control equipment that may fail around the year 2000 (Chapter 5).

2. Supply Internet links and contact points for equipment manufacturers (Chapter 6).

3. Identify the status of Y2K compliance for common equipment (Chapter 7).

Appendix: U.S. Army Installation Utility Y2K Readiness Table

Base	Utility	Awareness	Inventory	Assessment	Process Analysis	Implementation	Contingency Planning
Aberdeen PG	Baltimore Gas and Electric Co. [www.bge.com]	100%	100%	In process	In process	In process	100%
Belvoir	Virginia Power [www.vapower.com]	100%	100%	100%	93% (July 99)	93% (July 99)	100%
Benning	Georgia Power Co. [www.southernco.com]	100%	100%	100%	100%	70% (June 99)	50% (June 99)
	Southern Natural Gas Co. [www.sonat.com]	100%	100%	100%	100%	60% (July99)	60% (July99)
Bragg	Carolina Power & Light [www.cplc.com]	100%	UKN	UKN	UKN	UKN	UKN
	NCNG [www.ncng.com]	100%	100%	100%	95%	95% (July99)	UKN
Campbell	TVA	100%	100%	90%	50% (June99)	40% (November99)	UKN
	Clarksville Gas [www.tva.com]	100%	90%	70%	70%	(July 99)	50%
Carlisle Barracks	Pa. Power & Light Co. [www.ppl-inc.com]	100%	100%	100%	(July 99)	(July 99)	100%
	UGI Utilities [www.ugi.com]	100%	100%	100%	(June 99)	(June 99)	(June 99)
Carson	Colorado Springs Utilities [www.csu.org]	100%	100%	100%	100%	50% (December99)	UKN
Base	Utility	Awareness	Inventory	Assessment	Process Analysis	Implementation	Contingency Planning
Dix	GPU [www.gpu.com]	100%	100%	(June 99)	(June 99)	(June 99)	(June 99)
	PSE&G [www.pseg.com]	UKN	UKN	UKN	UKN	UKN	UKN
Drum	NYSEG [www.nyseg.com]	100%	100%	80%	80%	not reported	(July 99)
Eustis	Virginia Power [www.vapower.com]	100%	100%	100%	93% (July 99)	93% (July 99)	100%

Base	Utility	Awareness	Inventory	Assessment	Process Analysis	Implementation	Contingency Planning
Gillem	Georgia Power Co.	100%	100%	100%	100%	70% (June 99)	50% (June 99)
	Gas [www.southernco.com]	UKN	UKN	UKN	UKN	UKN	UKN
Gordon	Georgia Power Co.	100%	100%	100%	100%	70% (June 99)	50% (June 99)
	Gas [www.southernco.com]	UKN	UKN	UKN	UKN	UKN	UKN
Hood	Texas Utilities [www.tu.com]	100%	100%	100%	70%	70%	not reported
Jackson	SCE&G [www.scana.com/sce&g]	100%	100%	In process	UKN	UKN	UKN
Knox	LG&E [www.lgeenergy.com]	100%	100%	100%	55%	55%	55%
Lee	Virginia Power [www.vapower.com]	100%	100%	100%	93% (July 99)	93% (July 99)	100%
Leonard Wood	Show-Me Power Elec. [www.shomepower.com]	100%	100%	100%	100%	95% (April99)	100%
	UtiliCorp United [www.utilicorp.com]	100%	100%	100%	50% (June99)	(July 99)	50% (July99)
Lewis	Puget Sound Energy [www.pechoice.com]	100%	100%	100%	(April 99)	(July 99)	(September 99)
McNair	Pepco [www.pepco.com]	100%	100%	100%	not reported	(Mid 99)	not reported
	Washington Gas [www.washgas.com]	100%	100%	100%	100%	(June 99)	100%
Meade	Baltimore Gas and Electric Co. [www.bge.com]	100%	100%	In process	In process	In process	100%
Monmouth	GPU	100%	100%	(June99)	(June99)	(June 99)	(June99)
	Gas [www.gpu.com]	UKN	UKN	UKN	UKN	UKN	UKN
Myer	Virginia Power [www.vapower.com]	100%	100%	100%	93% (July 99)	93% (July 99)	100%

Base	Utility	Awareness	Inventory	Assessment	Process Analysis	Implementation	Contingency Planning
Picatinny	GPU Gas [www.gpu.com]	100%	100%	(June99)	(June99)	(June99)	(June99)
		UKN	UKN	UKN	UKN	UKN	UKN
Redstone	TVA [www.tva.com]	100%	100%	90%	50% (June99)	40% (November99)	UKN
	Huntsville Utilities [www.hsvutil.org]	100%	(Sept99)	75%	80%	75%	60%
Riley	Western Resources	100%	UKN	UKN	UKN	UKN	UKN
	Mountain Energy [www.wstnres.com]	100%	100%	100%	100%	100%	100%
Rucker	Alabama Power Power Co. [www.alagasco.com]	100%	100%	100%	100%	70% (June 99)	50% (June 99)
	Southern Natural Gas Co. [www.southernco.com]	100%	100%	100%	100%	60% (July99)	60% (July99)
Sill	PSCO	100%	100%	66%	In process	In process	In process
	ARKLA [www.psco.com]	UKN	UKN	UKN	UKN	UKN	UKN
Stewart	Georgia Power Co. [www.southernco.com]	100%	100%	100%	100%	70% (June 99)	50% (June 99)
	Atlanta Gas and Light [www.alagasco.com]	100%	100%	100%	(June99)	(June99)	70% (July99)
Wainwright	Golden Valley Elec.	100%	100%	100%	In process	In process	In process
	Gas [www.gvea.com]	UKN	UKN	UKN	UKN	UKN	UKN

USACERL DISTRIBUTION

Chief of Engineers
ATTN: CEMP-ET (2)
ATTN: CEHEC-IM-LH (2)
ATTN: CEHEC-IM-LP (2)
ATTN: CECC-R
ATTN: CERD-L
ATTN: CERD-M

Defense Tech Info Center 22304
ATTN: DTIC-O (2)

11
04/99

☆U.S. GOVERNMENT PRINTING OFFICE: 1999 - 746-070/80064